W-band Pointing at DSS-13

Paul Richter, Section 331
Dave Girdner, Section 333
David Rochblatt, Section 333
Phil Withington, Section 351

May 1, 2002

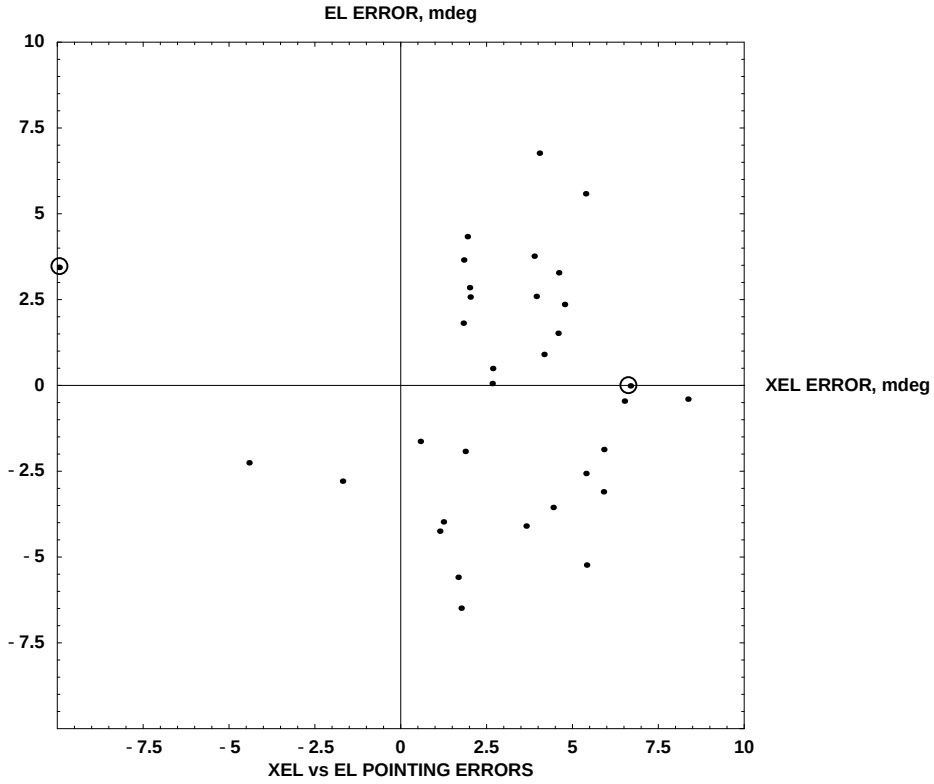
Results of Open-loop Conscan Pointing Data Acquisition DOY 030-031 and 072-073

- All data are X-band, acquired at the S-X feed position (ϕ = 238.05 deg).
- Data are all-sky (see coverage in appendix).
- DOY 030 - 031 data were acquired during daylight hours (≈ 8:00 AM - 4:00 PM, PST).
- DOY 072 - 073 data were acquired during nighttime hours (≈ 10:00 PM - 4:00 AM, PST).
- Due to various problems encountered during the runs, only DOY 031 and 072 data were useful, and the results discussed below are for these two days only.
- Wind speed was low during DOY 031 data acquisition (v ≈ 10 mph, see below).
- Wind speed was high during DOY 072 data acquisition (v ≈ 20 - 40 mph, see below).

W-band Task
Blind Pointing

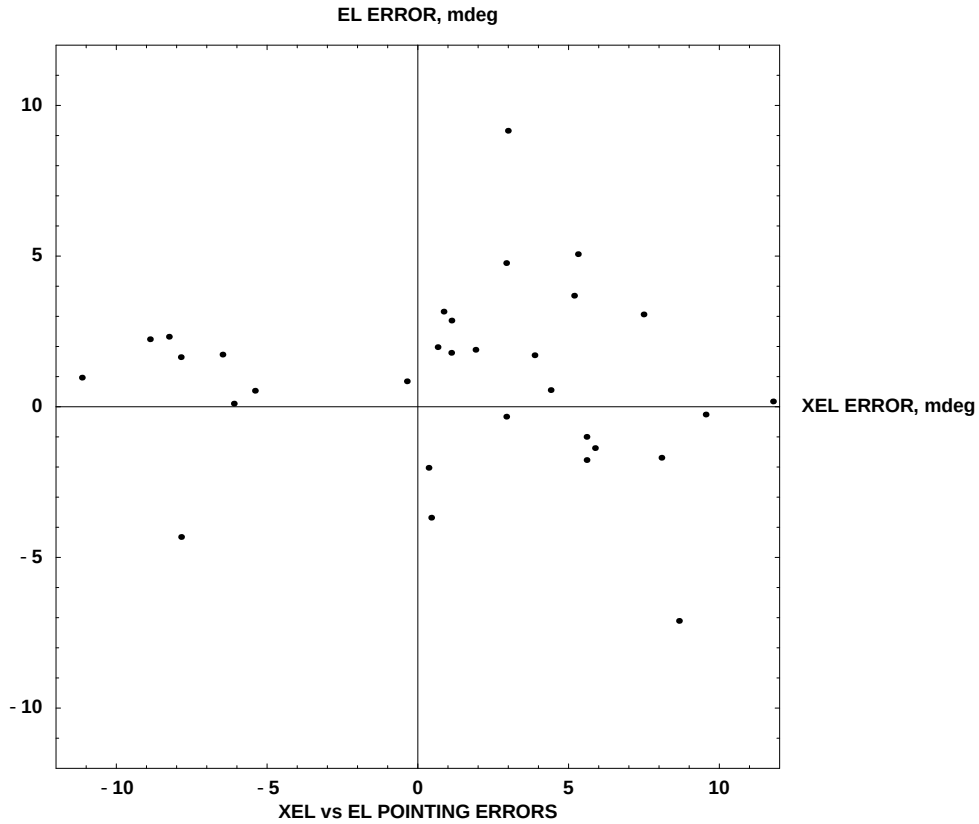
JPL

Results of Open-loop Conscan Pointing Data Acquisition
DOY 031



W-band Task
Blind Pointing

Results of Open-loop Conscan Pointing Data Acquisition DOY 072



Results of Open-loop Conscan Pointing Data Acquisition Comments on the Data

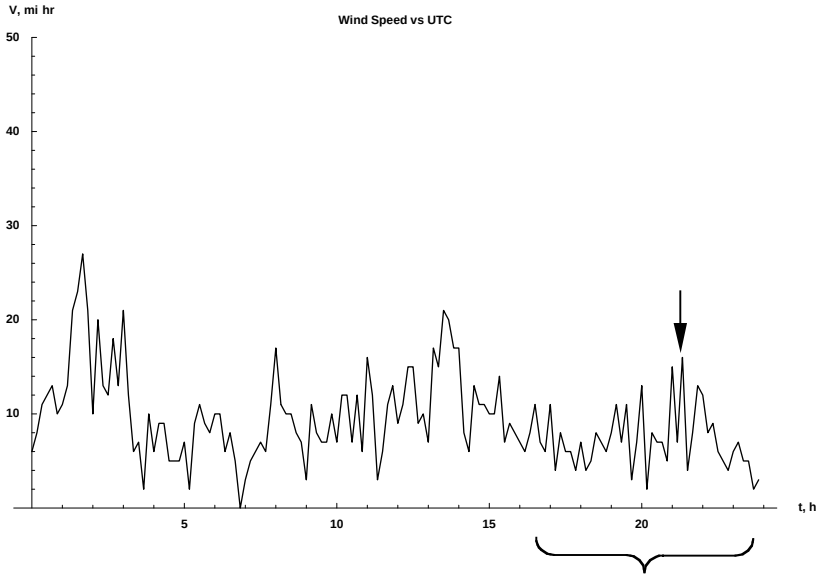
- The DOY 031 data show a positive XEL error bias of about 5 mdeg.
  - One outlier has a XEL error of -10 mdeg (see circled point at left).
- The DOY 072 data show about the same 5 mdeg XEL error bias, but also a cluster of points with XEL errors running from -5 to -11 mdeg.

W-band Task
Blind Pointing

JPL

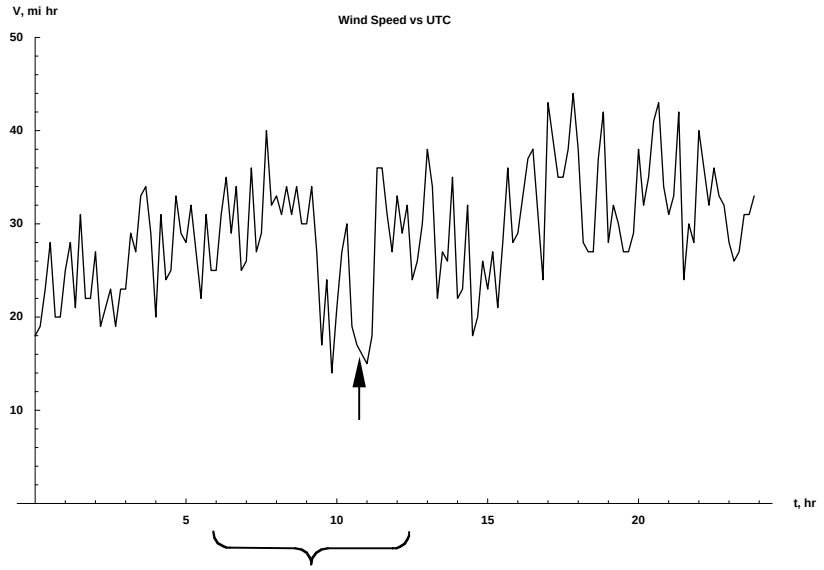
Results of Open-loop Conscan Pointing Data Acquisition
Comparison of Wind During the Two Runs

DOY 02031



Measurement period

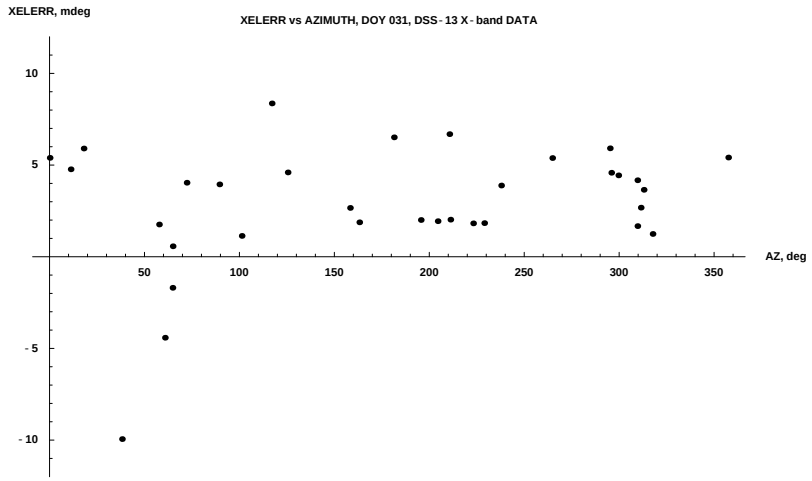
DOY 02072



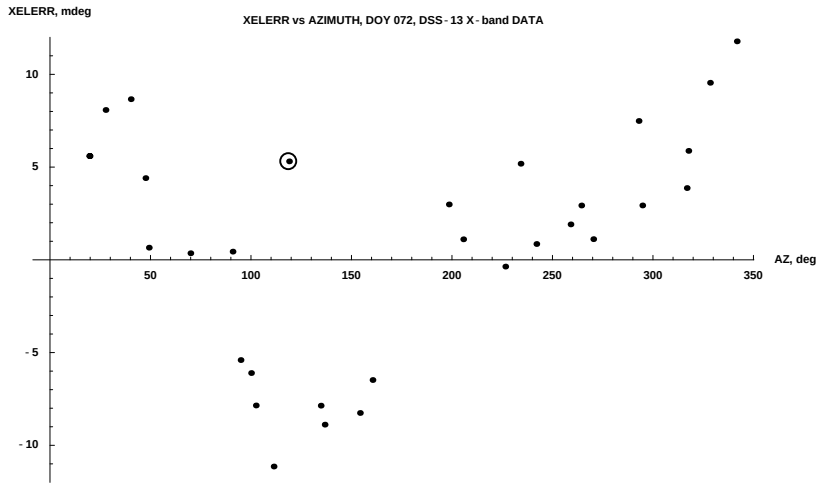
Measurement period

Results of Open-loop Conscan Pointing Data Acquisition
Comparison of XEL Errors vs Azimuth

DOY 02031



DOY 02072

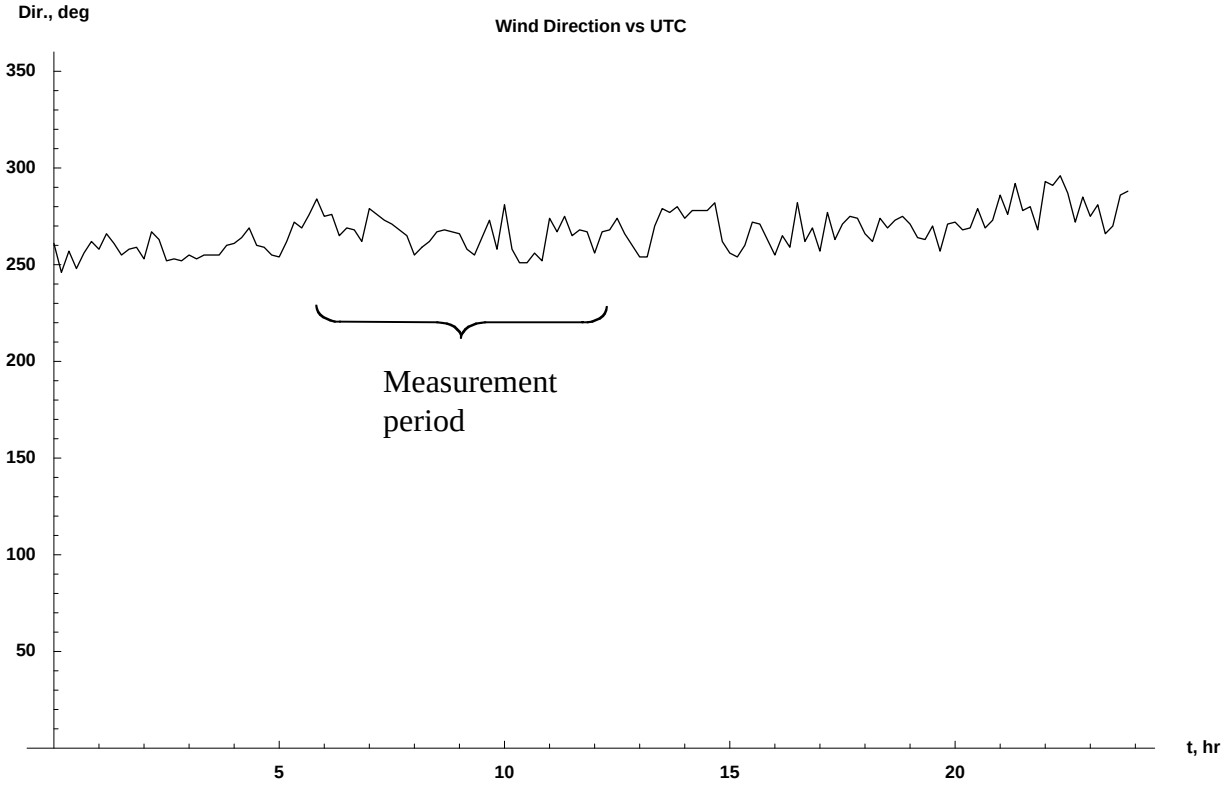


The DOY 02072 XEL error data show a strong correlation with azimuth, suggesting a wind effect. The circled point is an outlier.

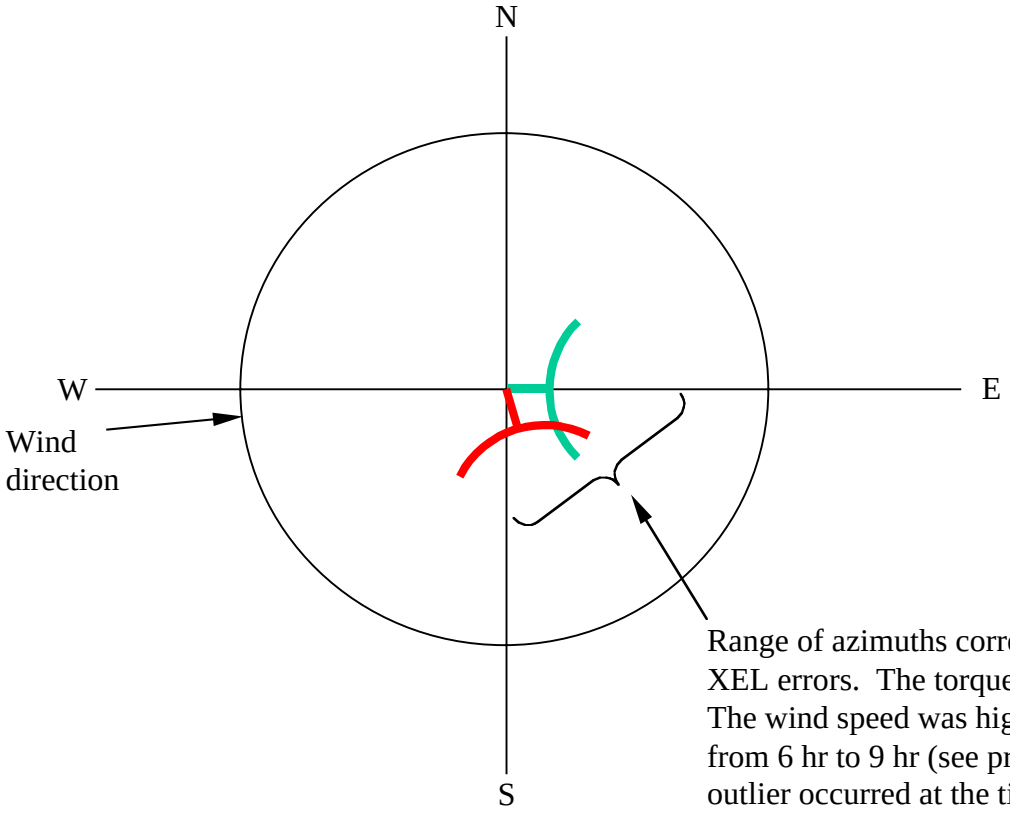
W-band Task
Blind Pointing

JPL

Results of Open-loop Conscan Pointing Data Acquisition
Wind Direction for DOY 02072 Data



Results of Open-loop Conscan Pointing Data Acquisition
Effect of Azimuth on XEL Pointing Errors During Wind



Range of azimuths corresponding to negative XEL errors. The torque produced is CCW. The wind speed was high during this period, from 6 hr to 9 hr (see previous plot, p. 6). The outlier occurred at the time shown by the arrow when the wind speed was low.

Results of Open-loop Conscan Pointing Data Acquisition Conclusion

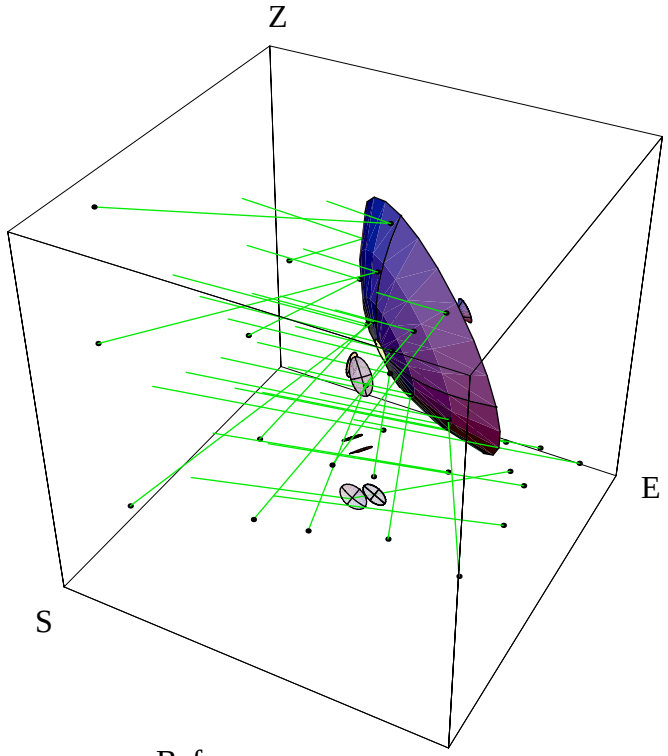
- The cluster of points in the scatter diagram for DOY 072 having negative XEL errors is most likely the result of strong winds producing CCW torques on the structure.
  - The data were acquired at night, so thermal effects should be minimal.

Results of Open-loop Conscan Pointing Data Acquisition

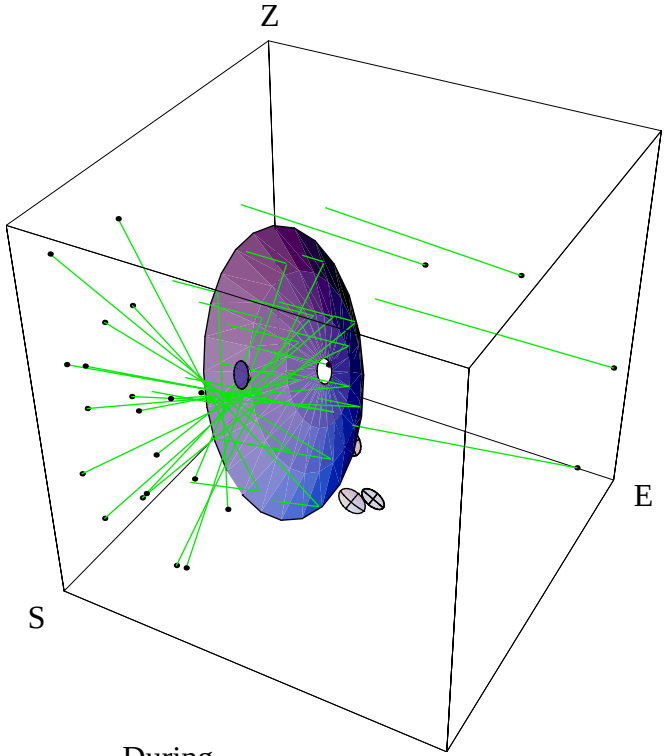
- Question: What caused the outliers with negative XEL error in the DOY 02031 data, when there was very little wind?
  - The two most negative XEL data points were acquired consecutively at approximately 1:30 PM PST.
  - Comparison of the Sun - Earth - Source angles immediately prior to, and during the measurements producing negative XEL errors shows a radical change (see figures on following page) - the before and during data points are circled in the scatter diagram, and indicate a XEL error change of minus 16.6 mdeg!
  - This large, thermally induced pointing change is consistent with measurements made earlier at DSS-26, where temporal changes were isolated from antenna pointing direction, and changes up to 10 mdeg were seen.
  - The before and during measurements were made at the time indicated on the wind speed plot (see arrow, p. 6), when the wind speed was < 15 mph.

Results of Open-loop Conscan Pointing Data Acquisition

Comparison of Solar Illumination Geometry Immediately Before and During the Period of Large Negative XEL Errors



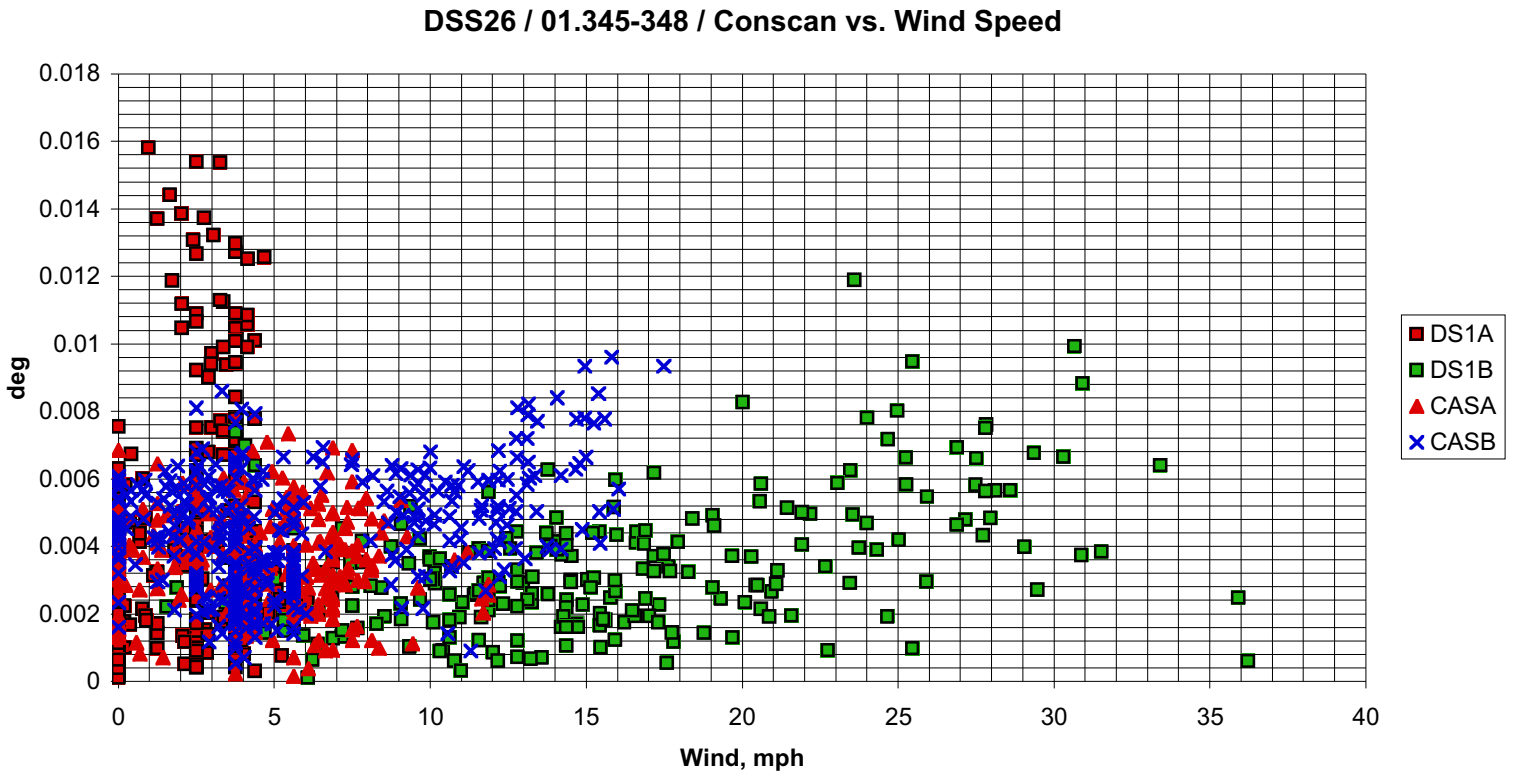
Before



During

Results of Open-loop Conscan Pointing Data Acquisition

Comparison With Pointing Data Acquired at DSS-26 by Mike Wert



The DS1A data set (red squares) was acquired with almost no wind, but shows large thermally induced mean radial pointing errors. The DS1B data set (green squares) was acquired with high winds.

Results of Open-loop Conscan Pointing Data Acquisition General Conclusions

- The DOY 02031 and 02072 data sets provide a means for separating thermal and wind induced pointing error effects
  - The DOY 02031 data were obtained with very little wind, but during daylight hours, while the DOY 02072 data were acquired under high wind conditions at night.
- If both thermal and wind effects are ignored, the bulk of the data show a systematic +5 mdeg bias in XEL error
  - The cause of this needs to be pursued, but attempts to account for it on the basis of a feed offset have been unsuccessful
    - A least-squares fitting to determine a radial and azimuthal feed offset resulted in an *increase* in chi-square.
- Future pointing measurements should be made at night with little wind, if possible
  - The archived DSS-13 wind data should be analyzed to determine the best times to make such measurements.

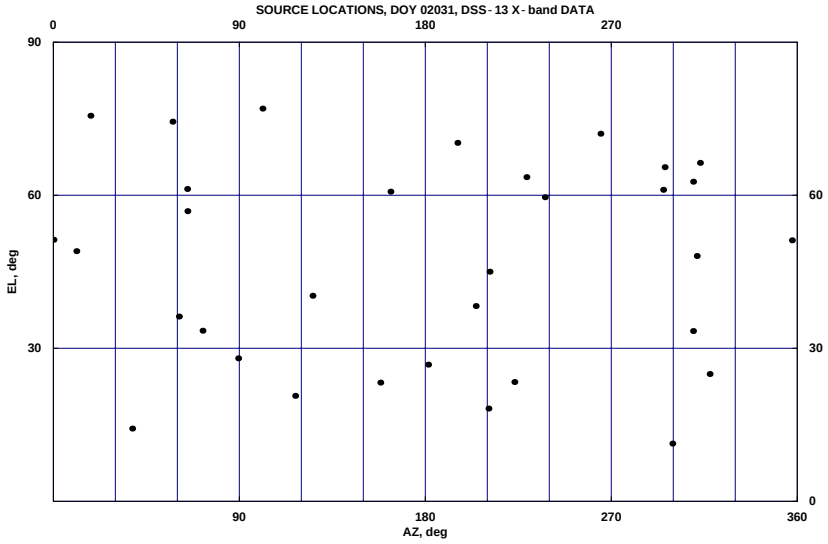
Results of Open-loop Conscan Pointing Data Acquisition

Appendix

W-band Task
Blind Pointing

Results of Open-loop Conscan Pointing Data Acquisition
All-sky Coverage

DOY 02031



DOY 02072